URC-101.104 P.S.

PTAD-101 POWER SUPPLY

MOTOROLA INC.

Government Electronics Group

PTAD-101 POWER SUPPLY

Document No. 68-P09158W
April 1983

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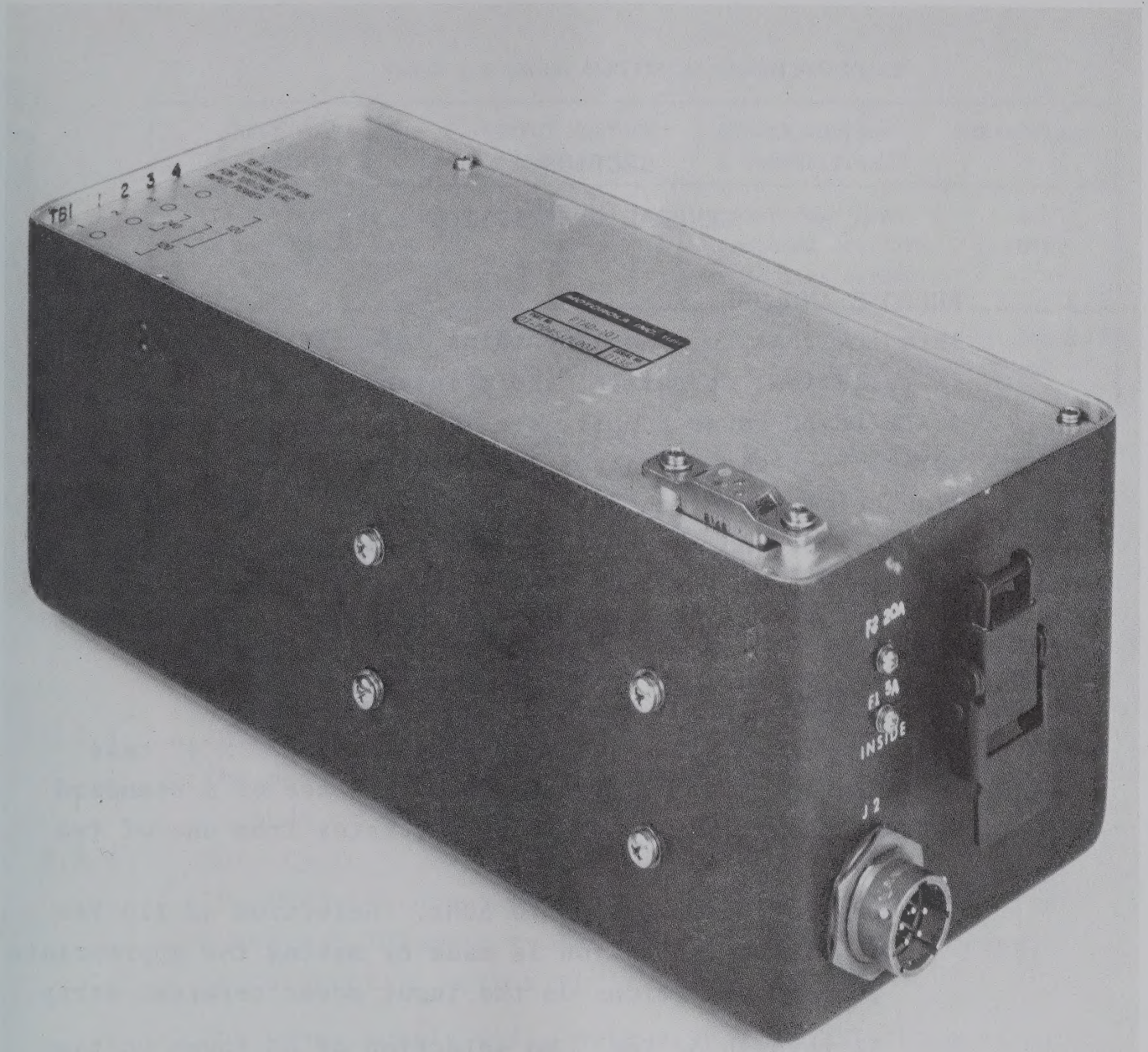

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Figure 1-1. PTAD-101 Power Supply

SECTION I

GENERAL DESCRIPTION

1.1 PURPOSE AND USE

1.2 This instruction manual contains information on the installation, operation, and maintenance of the PTAD-101 AC-DC/DC-DC Power Supply (see figure 1-1) for the PT series Portable Emergency Transceivers (PET). These transceivers include PET Models PT-25A, AN/URC-100, AN/URC-101, and AN/URC-104. The power supply converts 120/240 Vac or 11-32Vdc to a voltage suitable to operate a 5 or 20 Watt PET Transceiver.

1.2.1 GENERAL DESCRIPTION

The power supply is housed in a 5.0" x 11.7" x 4" case and attaches to a PET transceiver in place of a standard battery pack. The power supply operates from one of two power sources:

a. Single phase ac 47Hz to 60Hz. Selection of 120 Vac or 240 Vac operation is made by making the appropriate jumper connections on the input power terminal strip.

b. 11 through 32 Vdc. No selection of DC input voltage is necessary.

1.3 EQUIPMENT CHARACTERISTICS

1.3.1 The major electrical characteristics of the power supply are listed in Table 1-1.

TABLE 1-1 MAJOR ELECTRICAL CHARACTERISTICS

INPUT VOLTAGE & CURRENT	OUTPUT VOLTAGE & CURRENT	RIPPLE VOLTAGE & COMPOSITION	PROTECTION
120 Vac/240 Vac ±10% 47 to 60 Hz @ 3A	24 Vdc @4A	100mV-full load; composed of: 27KHz & AC line harmonics	5A FUSE
11Vdc @ 16.5A Max to 32Vdc @ 4.5A Max	24Vdc @4A	100mV - full load composed of: 27KHz	20A FUSE

1.3.2 Automatic Switchover

The power supply will automatically switchover to the dc mode of operation in the event of an ac power failure.

1.3.3 Duty Cycle

The PTAD-101 power supply is designed to operate with a nominal 10% duty cycle (10% transmit, 90% receive) in conjunction with a PET transceiver.

The power supply will, with a 20 watt PET transceiver, provide the necessary energy for prolonged 20 watt transmission of 30 minutes maximum at +25^{o}C ambient. Transmission greater than 30 minutes will activate a thermal switch within the PET transceiver which will cut the transmitter power to 5 watts, or, will activate a thermal switch within the PTAD-101 power supply which will shut down the power supply. After a "cool down" period either or both thermal switches will cool down and the 20 watt transmissions will return to normal.

> **CAUTION**
>
> Do not defeat the action of the thermal switches. Doing so could cause serious damage to the PET transmitter circuits or to the PTAD-101 power supply circuits.

1.3.4 Temperature

The ambient operating temperature (measured with sun load) of the power supply is -20°C to +55°C. Storage temperature is -20°C to +75°C.

1.4 EQUIPMENT SUPPLIED

The PTAD-101 power supply is comprised of the items listed in Table 1-2.

Table 1-2. Equipment Supplied

Description	Part Number
PTAD-101 Power Supply	01-P04537L003
Technical Manual	68-P09158W
AC Power Cable	30-P09258W002
DC Power Cable	30-P09258W003

SECTION II

INSTALLATION AND OPERATION

2.1 INSTALLATION TO PET

The PTAD-101 Power Supply attaches to the PET Transceiver in the same manner as a standard PET battery pack. (See figure 2-1).

2.2 OPERATION OF PET

a. With the PTAD-101 Power Supply attached to the PET Transceiver and properly externally powered, the operation of the PET Transceiver is the same as with a battery pack. There are no special precautions in the operation of the PET Transceiver.

b. When the external power is applied to the PTAD-101, the power supply is on. There is no separate ON/OFF switch on the PTAD-101. The ON/OFF switch on the PET Transceiver turns the PET on or off and does not affect the PTAD-101.

2.3 EXTERNAL ELECTRICAL CONNECTIONS

2.3.1 AC Input Connections

a. All PTAD-101 power supplies are factory wired for 120Vac. Two internal jumpers have to be properly moved to connect the power supply to 240 Vac. Figure 2-2 shows the 120 Vac and the 240 Vac wiring connections for terminal strip TB1. To gain access to TB1 perform the following steps:

Figure 2-1. PTAD-101 Power Supply Attached To PET Transceiver

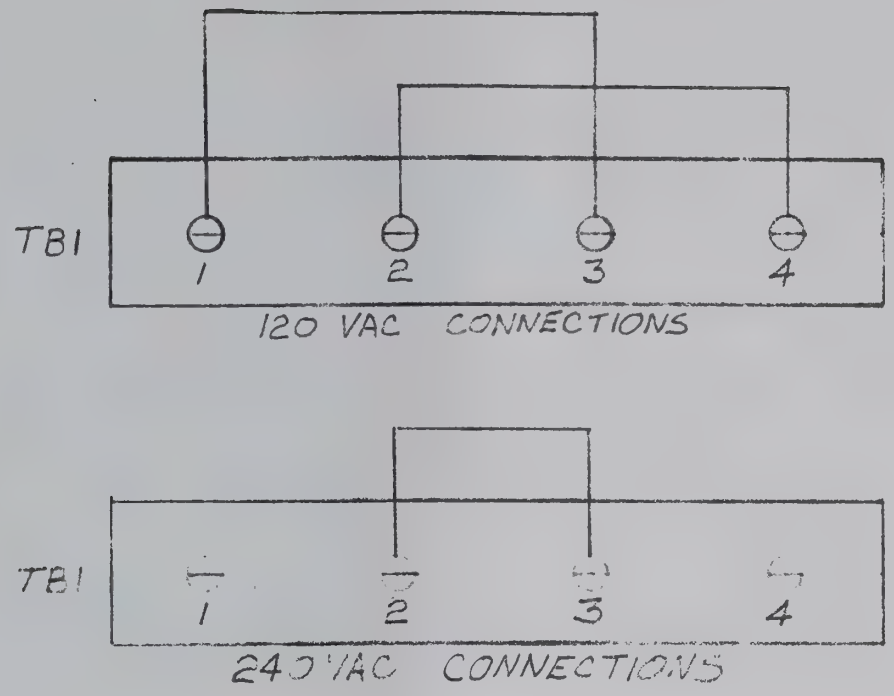

FIGURE 2-2
120/240 VAC CONNECTIONS

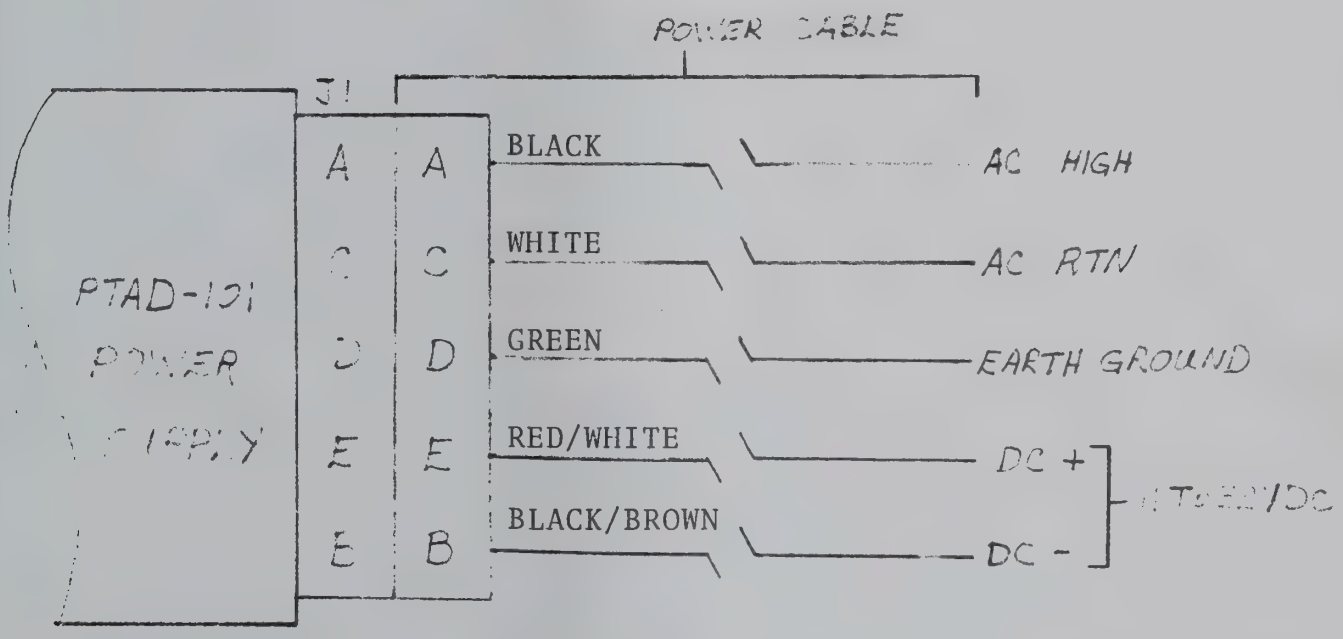

FIGURE 2-3
PTAD-101 INPUT POWER CONNECTIONS

> **WARNING**
> Ensure that all power is removed from the power supply before attempting to change connections on terminal strip, TB1.

1. Remove the four screws securing the cover to the case.
2. Remove the two screws securing the protective shield over TB1.
3. Connect jumper wires as required (See Figure 2-2).
4. Replace protective shield over TB1 and the cover over the power supply.
5. Change the voltage on the cover using an eraser and a No. 2 pencil.

b. Connect the mating connector of the AC Power Cable (supplied) to the J1 input connector on the PTAD-101. Connect the other end of the AC Power Cable to the appropriate AC Power Source.

c. If another type of AC power plug is to be used, the three wires from the AC Power Cable are to be connected to the AC source as follows: (Reference Figure 2-3)

BLACK	AC HIGH
WHT	AC RTN
GRN	EARTH GROUND

2.3.2 DC Input Connections

Connect the mating connector of the DC Power Cable (supplied) to the J1 input connector on the PTAD-101.

The DC Power Cable will accept 11.0 Vdc to 32.0 Vdc. There are no internal strapping requirements for the dc input on the PTAD-101. The PTAD-101 will accept the 11 to 32 Vdc input with no extra internal strapping or modifications. Connect the wires on the DC Power Cable to an appropriate DC source as follows: (Reference Figure 2-3).

RED & WHITE	DC +
BLACK & BROWN	DC -

2.4 POWER SUPPLY OUTPUT ADJUSTMENTS

a. Before attempting any adjustments of the power supply, fabricate a load resistor that will provide a 4.0A load at the output of J2. A 6-ohm resistor rated at 200 watts will suffice.

b. The output voltage adjustment is accomplished by adjusting R25 (see Figure 4-4). Adjusy R25 for 28.0 Vdc $\frac{+0.2\text{Vdc}}{-0.1\text{Vdc}}$ at the collector of Q9 (see Figure 4-2) with a 20 Vdc input at pin E of J1. Clockwise rotation increases voltage; counterclockwise rotation decreases voltage.

CAUTION
This potentiometer, R25, is very sensitive. Rotate it very slowly.

c. The output current limit adjustment is accomplished by adjusting R26 (see Figure 4-4). With an 11V input at pin E of J1, adjust R26 clockwise until the 28Vdc at the collector of Q9 just begins to decrease. Next turn R26 counterclockwise just to the point where the 28Vdc is again restored.

2.5 OPERATOR MAINTENANCE

Operator maintenance on the power supply is limited to minor repairs that do not involve disassembly of component parts. Maintenance is performed when inspection dictates the need. Periodically:

a. Tighten loose hardware; replace any missing hardware.
b. Clean power supply using a soft cloth, dampened (not wet) with soapy water.
c. Touchup the surface of the power supply using Color No. 24087 per FED-STD-595, Semigloss Enamel Class A per TT-P-757.

SECTION III

THEORY OF OPERATION

3.1 GENERAL

The PTAD-101 is an all solid-state switching boost regulator type power supply. In the following paragraphs, the block diagram of Figure 3-1 and the schematic Figure 3-2, the theory of operation of the PTAD-101 will be outlined.

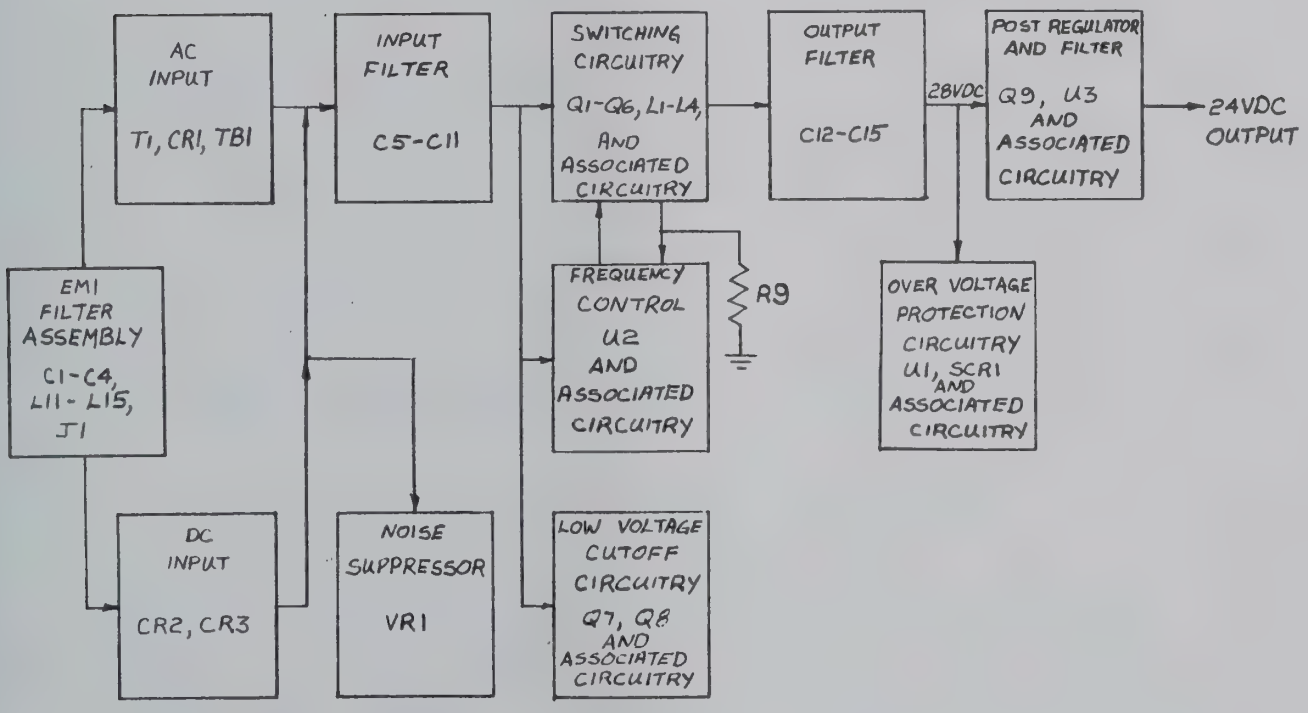

Figure 3-1. PTAD-101 Power Supply Block Diagram

3.2 EMI FILTER AND AC/DC INPUT CIRCUITS

The EMI filter is used primarily to prevent the 27 KHz power supply chopper frequency from exiting the power supply via the input power connector J1. It also distributes the ac and dc input voltages to their proper circuits.

The ac input circuitry takes the 120 Vac/240 Vac and converts it to approximately 20 Vdc. This voltage becomes the voltage to power the power supply circuits. This voltage through the switching boost regulator circuitry also becomes the 28 Vdc pre-output voltage.

The dc input circuitry allows the 11.0 to 32.0 Vdc to power the power supply. Diodes CR2 and CR3 protect the power supply in case dc polarity is incorrectly connected.

3.3 INPUT NOISE SUPPRESSOR AND FILTER

The input noise suppressor consists of VR1. In the event the dc input voltage or the rectified ac input voltage should have noise spikes exceeding 39Vdc, VR1 will suppress them.

Capacitors C5 through C11 filter the rectified ac.

3.4 FREQUENCY CONTROL AND LOW VOLTAGE CUTOFF CIRCUITRY

Oscillator U2 generates a chopper frequency of approximately 27KHz which is divided by 2 at the push-pull output, pins 8 and 11. This frequency is determined by the value of resistors R23 and R24 and capacitor C29.

If the dc input voltage drops below 10Vdc, transistors Q7 and Q8 detect this and shut down U2. This will shut down the switching transistor circuitry and the output voltage will drop to the 10V input voltage.

3.5 SWITCHING BOOST REGULATOR CIRCUITRY AND OUTPUT FILTER

The push-pull output of U2 turns Q1 thru Q4 on and off. This in turn causes Q5 and Q6 to turn on and off in a push-pull manner. When transistors are turned on the resultant current flow through coils L1, L2, L3, and L4 generate a field about these coils. When the transistors are turned off,the field provides an inductive kick-back voltage, charging output capacitors C12 through C14 thru diodes CR6 thru CR9. The on/off time of Q5 and Q6 is determined by the amount of feedback voltage to pin 2 of U2, via voltage adjust potentiometer R25. This feedback voltage controls the pulse width of the output of U2, which in turn determines the pre-output voltage level.

3.6 SHORT CIRCUIT PROTECTION

All the return current for the switching circuitry must pass through resistor R9. An overload or shorted condition causes the voltage drop across R9 to increase. This increased voltage is applied to potentiometer R26 and then to U2. The increased voltage at U2 will change the push-pull pulse widths and thereby decrease the pre-output voltage.

3.7 PREOUTPUT OVERVOLTAGE PROTECTION CIRCUITRY

Integrated circuit U1 and SCR1 provides overvoltage protection to the post regulator and filter in the event that the ac or dc input voltage exceeds 32 volts. If, for example, the dc input voltage begins to exceed what the pre output voltage is adjusted for, then the input voltage automatically becomes the preoutput voltage of the power supply and will override the switching boost regulator circuitry. If the dc voltage continues to climb, then U1 will turn on at a pre-output voltage of approximately 32 volts, thereby firing SCR1. When SCR1 fires, the fuses F1 or F2 will blow (in this example

fuse F2 will blow) thereby shutting down the entire power supply.

3.8 POST REGULATOR AND FILTER

The post regulator and filter primarily serves as a filter for the PET Transceivers which have a wide audio bandwidth. The ac line harmonics and the chopper harmonic related frequencies of the power supply fall within this wide audio bandwidth. Unfiltered, this would create high hum and noise in the PET Transceiver. Integrated circuit U3 provides a very high degree of ripple rejection. Devices U3, Q9, R33, R34 and C16 thru C18 create an electronic filter and regulator that provides a clean +24Vdc to the PET transceiver.

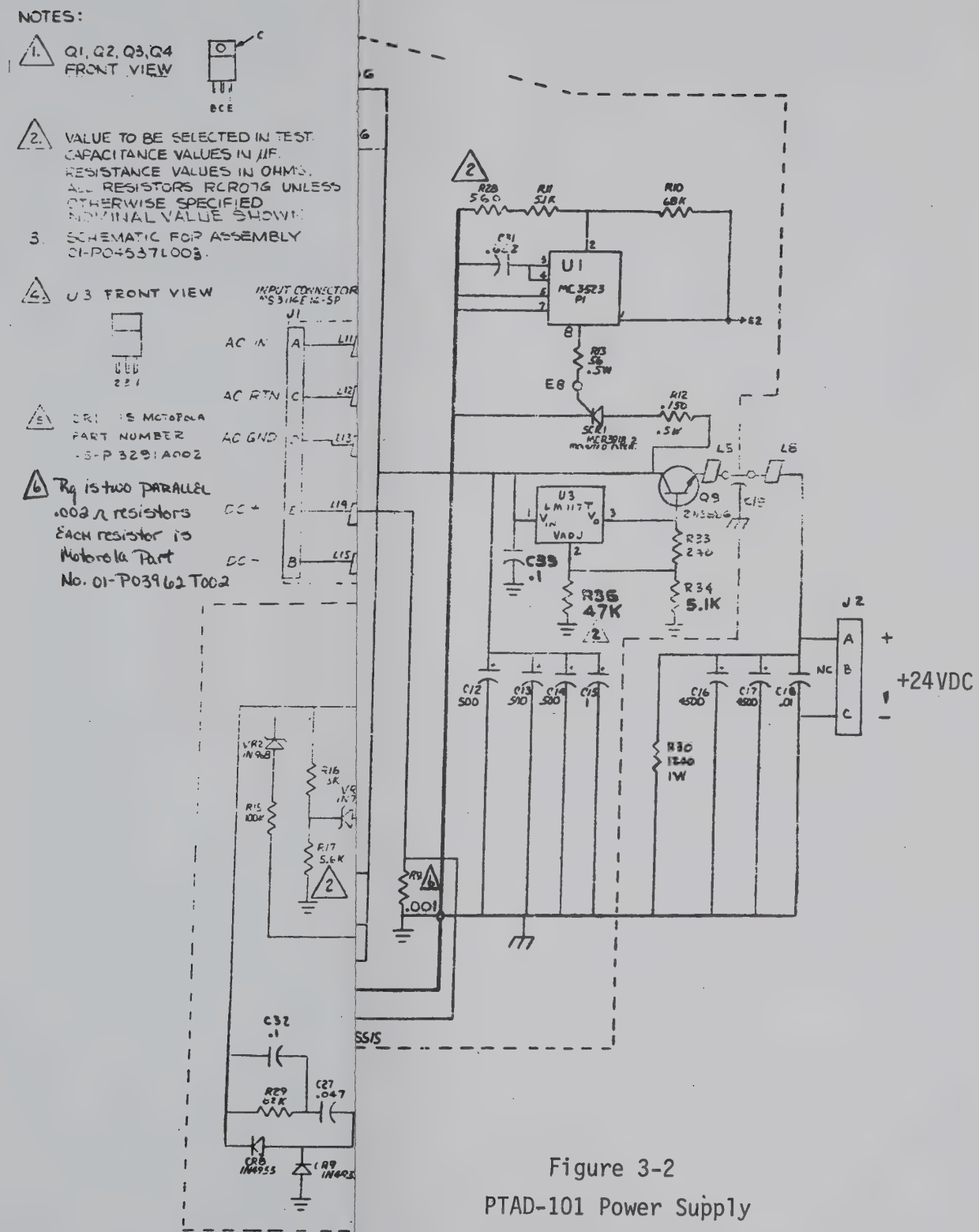

Figure 3-2
PTAD-101 Power Supply
Schematic Diagram

fuse F2 will blow) thereby shutting down the entire power supply.

3.8 POST REGULATOR AND FILTER

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NOTES:

1. Q1, Q2, Q3, Q4 FRONT VIEW

2. VALUE TO BE SELECTED IN TEST. CAPACITANCE VALUES IN μF. RESISTANCE VALUES IN OHMS. ALL RESISTORS RCR07G UNLESS OTHERWISE SPECIFIED. NOMINAL VALUE SHOWN.

3. SCHEMATIC FOR ASSEMBLY 01-P045371003.

4. U3 FRONT VIEW

5. CR1 IS MOTOROLA PART NUMBER -5-P 329-A002

6. R9 IS TWO PARALLEL .002 Ω RESISTORS EACH RESISTOR IS Motorola Part No. 01-P03962 T002

240 VAC
120 VAC
TB1
T1
BRN
RED
ORANGE
YELLOW
CR1 SCBA2
AC 1
AC 2
L6
SUBCHASSIS
INPUT CONNECTOR MS3106E-12-5P
J1
AC IN
AC RTN
AC GND
DC +
DC -
F1 5A
F2 20A
L11
L12
L13
L19
L15
C3 1200pF
C4 1200pF
CR2 1N4933
L7
CR3 IN6096
L10
VR1 V39ZA6
C5 12,000
C6 12,000
L9
C8 500
C9 500
C10 500
C11 1
TF3833D
L8 TF3834A
CR6 IN6096
CR7 IN6096
R1 100
Q1 D45H10
R2 560 2W
C34 2200pF
CR8 IN4933
CR7 IN4933
Q5 2N6339
C20 50
R7 100
Q2 D44H10
R3 47
R4 47
Q3 D44H10
R8 82
C21 50
R5 560 2W
C35 2200pF
CR4 IN4933
CR5 IN4933
Q6 2N6339
Q4 D45H10
R6 470
E8
TF3834A
TF3833D
CR8 IN6096
CR9 IN6096
R9 .001
R28 560
R11 51K
R10 68K
U1 MC3523 P1
R3 56 .5W
R12 150 .5W
SCR1 MC3823 P2 MOUNTED
Q9 2N5190
L5
L6
U3 LM117T
VADJ
C33 .1
R36 47K
R23 240
R34 5.1K
C12 500
C13 500
C14 500
C15 1
C16 4500
C17 4500
C18 .1
R30 1200 1W
J2
+24VDC
R16 3K
VR3 IN753B
R19 4.7K
Q8 2N2222A
Q7 IN2222A
R15 100K
R17 5.6K
R18 8.2K
C28 .1
R27 1M
U2 TL494CJ
S1 8BTF3-33
C25 .1
R22 10K
C24 1 TANT.
R24 12K
C29 2200pF MICA
R23 9100
C32 .1
R29 68K
C27 .047
CR8 IN4933
CR9 IN4933
R25 10K
C30 .0047
R26 100
C22 50
C23 50
R20 220 .5W
R21 220 .5W
R13 10 .5W
C26 .1
SUBCHASSIS

Figure 3-2
PTAD-101 Power Supply
Schematic Diagram

SECTION IV

PARTS LIST

4.1 ILLUSTRATIONS AND PARTS LIST

The following pages of this section illustrate and tabulate the assemblies of the PTAD-101 Power Supply. Mechanical parts are shown but are not tabulated. All major electrical components are illustrated and tabulated.

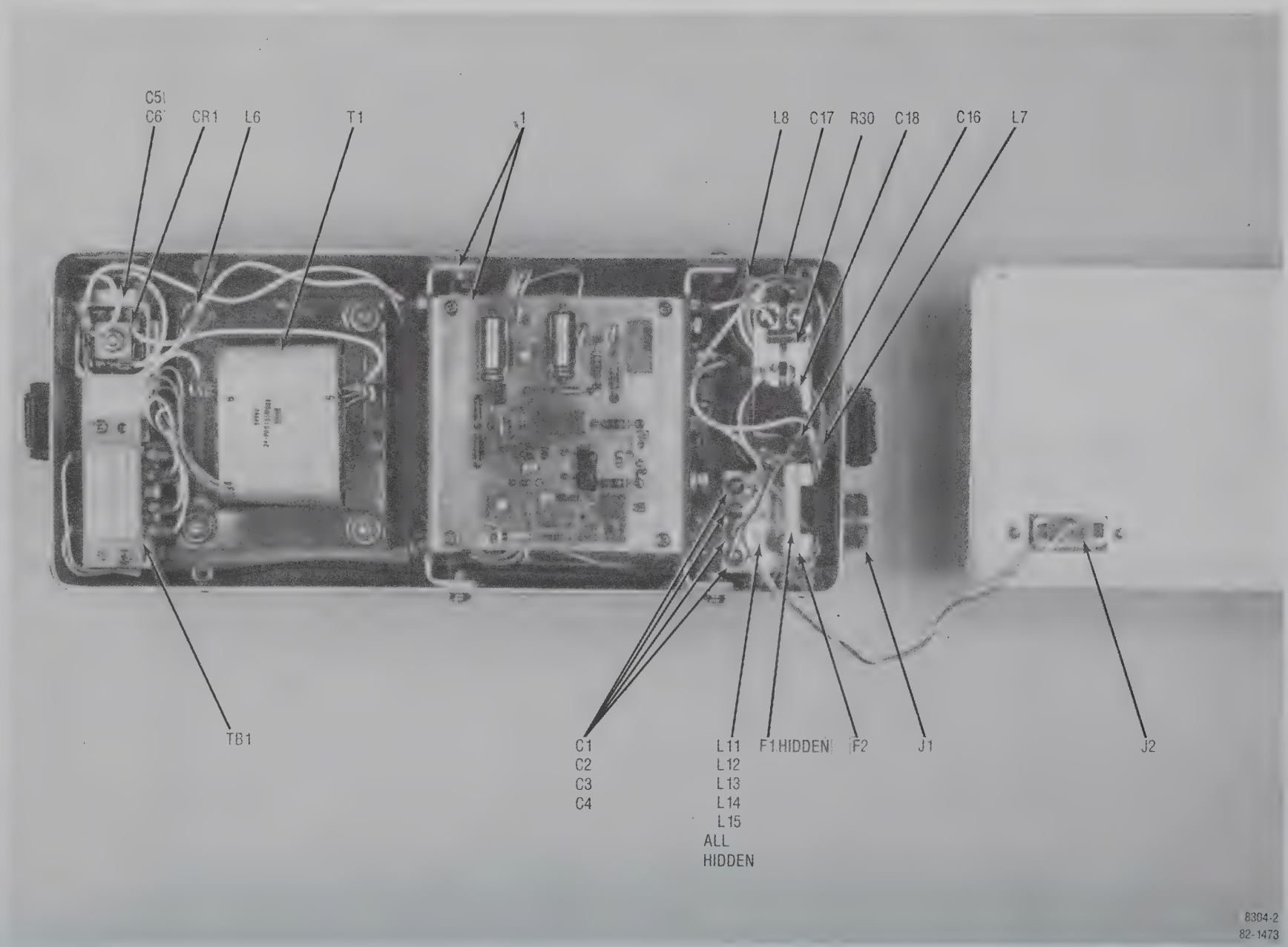

Figure 4-1. PTAD-101 Power Supply Parts Location Diagram

Table 4-1. PTAD-101 01-P04537L003, Power Supply Parts List
(See Figure 4-1)

Reference Designation	Description	Part Number
1	Converter Control Assy	01-P07251L002
C1,C2,C3,C4	1200 pf -350V	21-14071A14
C5,C6	12,000µf 35V	622D123M035AC2A
C16,C17	4500 µf 35V	622D452M035AA2A
C18	0.01µf	CM07DF103J03
CR1	Diode, Bridge	48-P13291A002
F1	5A Fuse	F02A250V5A
F2	20A Fuse	F03A125V20A
J1	Connector	MS3114E14-5P
J2	Connector	ON10173
L6,L7,L8,L11	Ferrite Bead	10273
L12,L13,L14		
L15		
R30	1200, 5% 1W	RCR32G122JS
T1	Power Transformer	24-P09155W001
TB1	Barrier Strip	37TB4

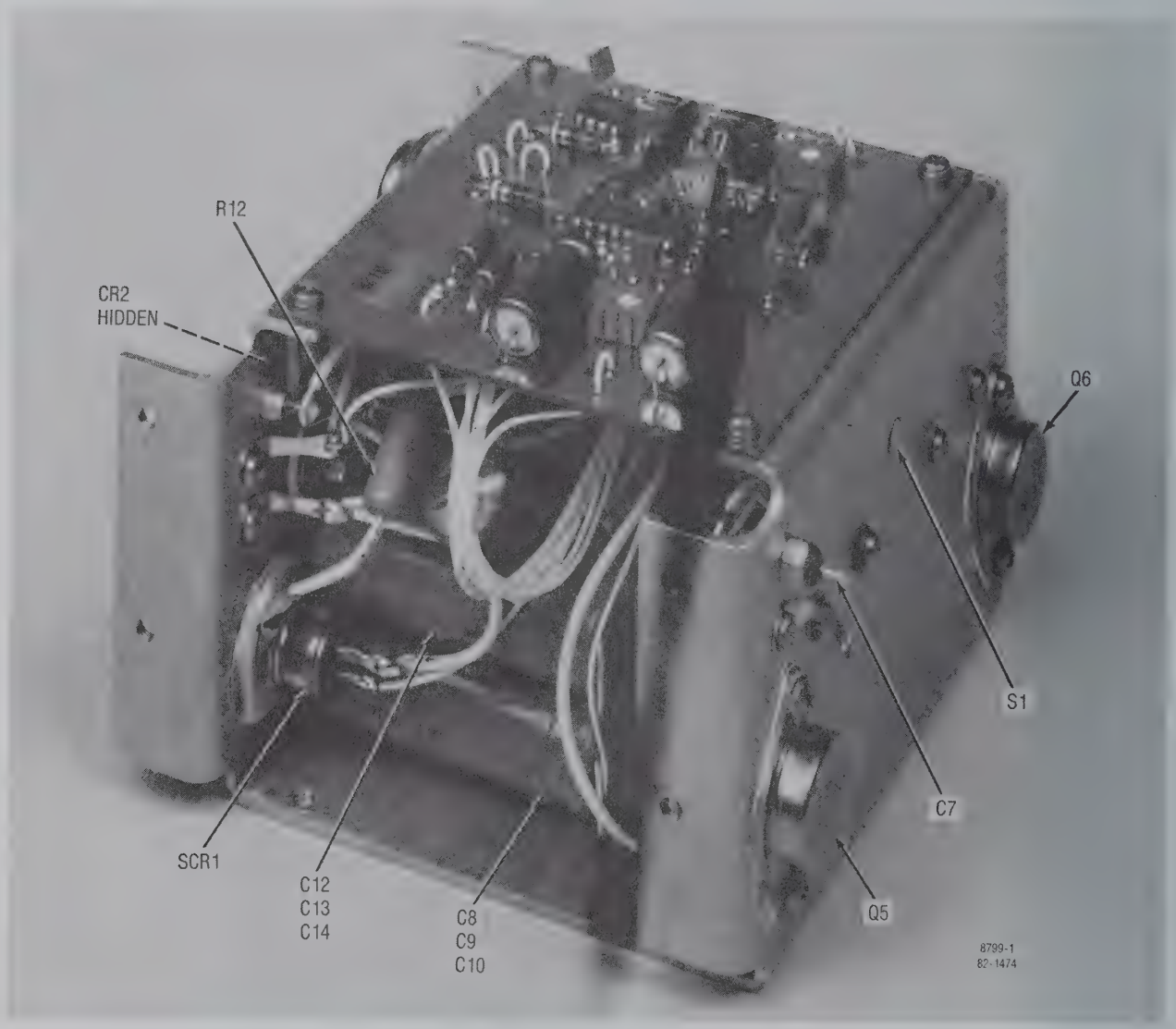

Figure 4-2A. Converter Control Assembly Parts Location Diagram

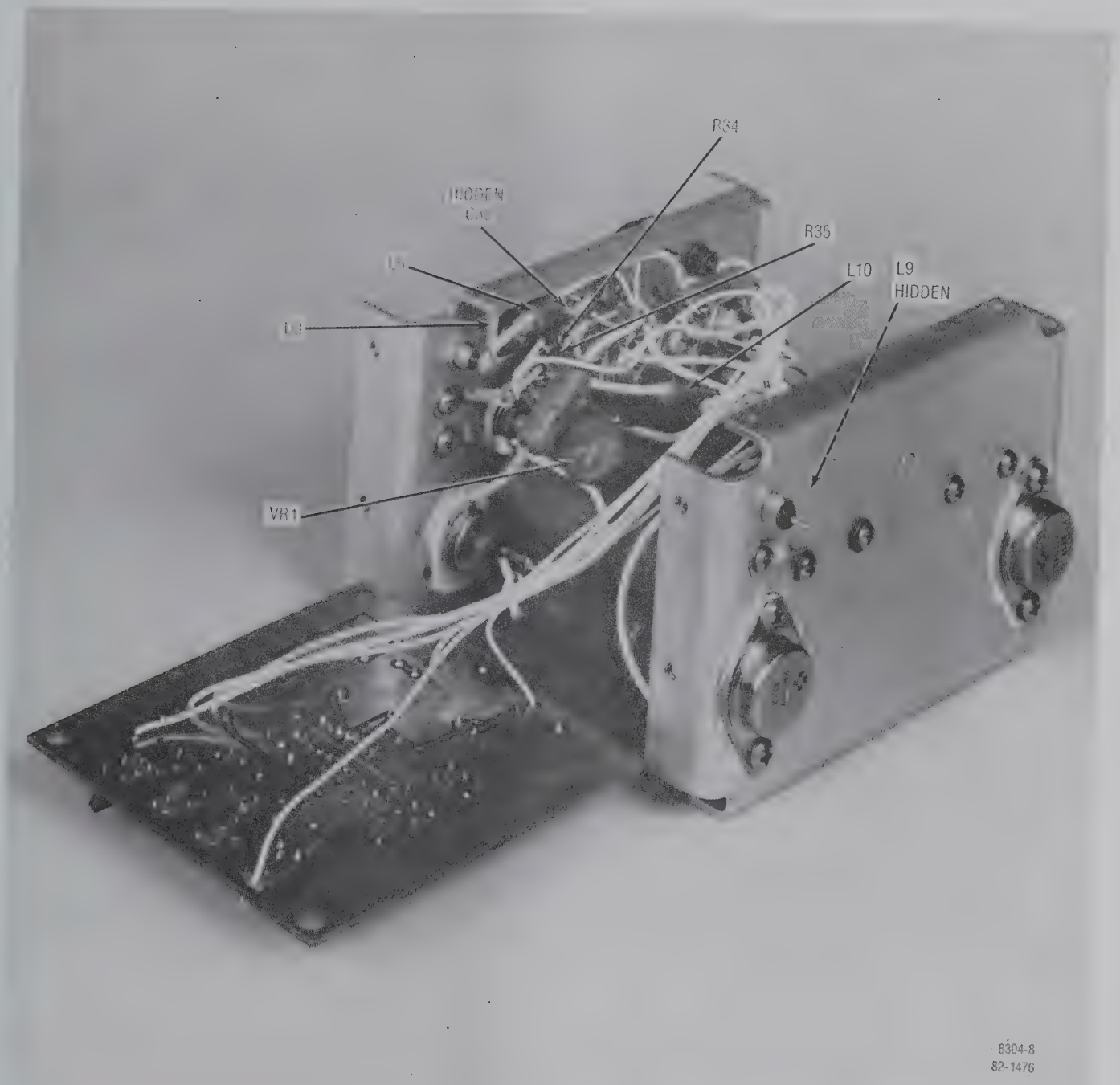

Figure 4-2B. Converter Control Assembly Parts Location Diagram

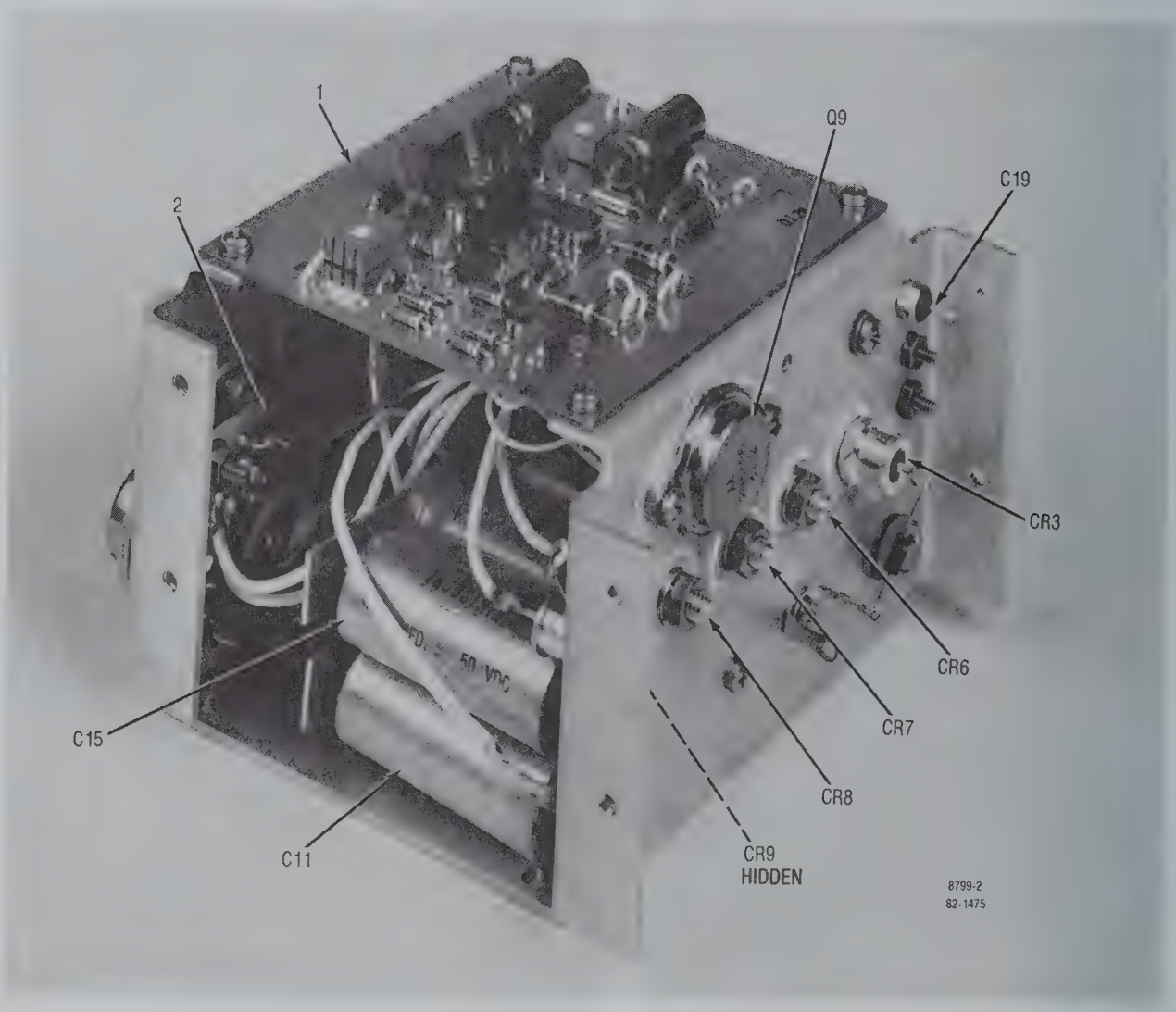

Figure 4-2C. Converter Control Assembly Parts Location Diagram

Table 4-2. Converter Control Assy 01-P07251L002
Parts List
(See Figure 4-2)

Reference Designation	Description	Part Number
1	Control PWB Assy	01-P04558L002
2	Converter PWB Assy	01-P07252L002
C7, C19	1200 pf	21-14071A14
C8, C9, C10 C12, C13, C14	500 µ F, 50V	39D507G050GL4
C11, C15	1.0 µ f, 50V	722791-1
C33	.1µf, 10%, 100V	M39014/02-1350
CR2	Diode	1N4933
CR3,CR6,CR7 CR8,CR9	Diode	1N6096
L5, L9, L10	Ferrite Bead	10273
Q5,Q6	Transistor	2N6339
Q9	Transistor	2N5686
R12	0.150Ω, 5W	1500NSB-.15-1
R33	240,5%, ¼W	RCR07G241JS
R34	5100, 5%, ¼W	RCR07G512JS
R35	47K, 5%, ¼W	RCR07G473JS
SCR1	Diode	MCR3918-2
S1	Thermal Switch	3BTF3-33
U3	Integrated Circuit	LM317T
VR1	Suppressor	V39ZA6

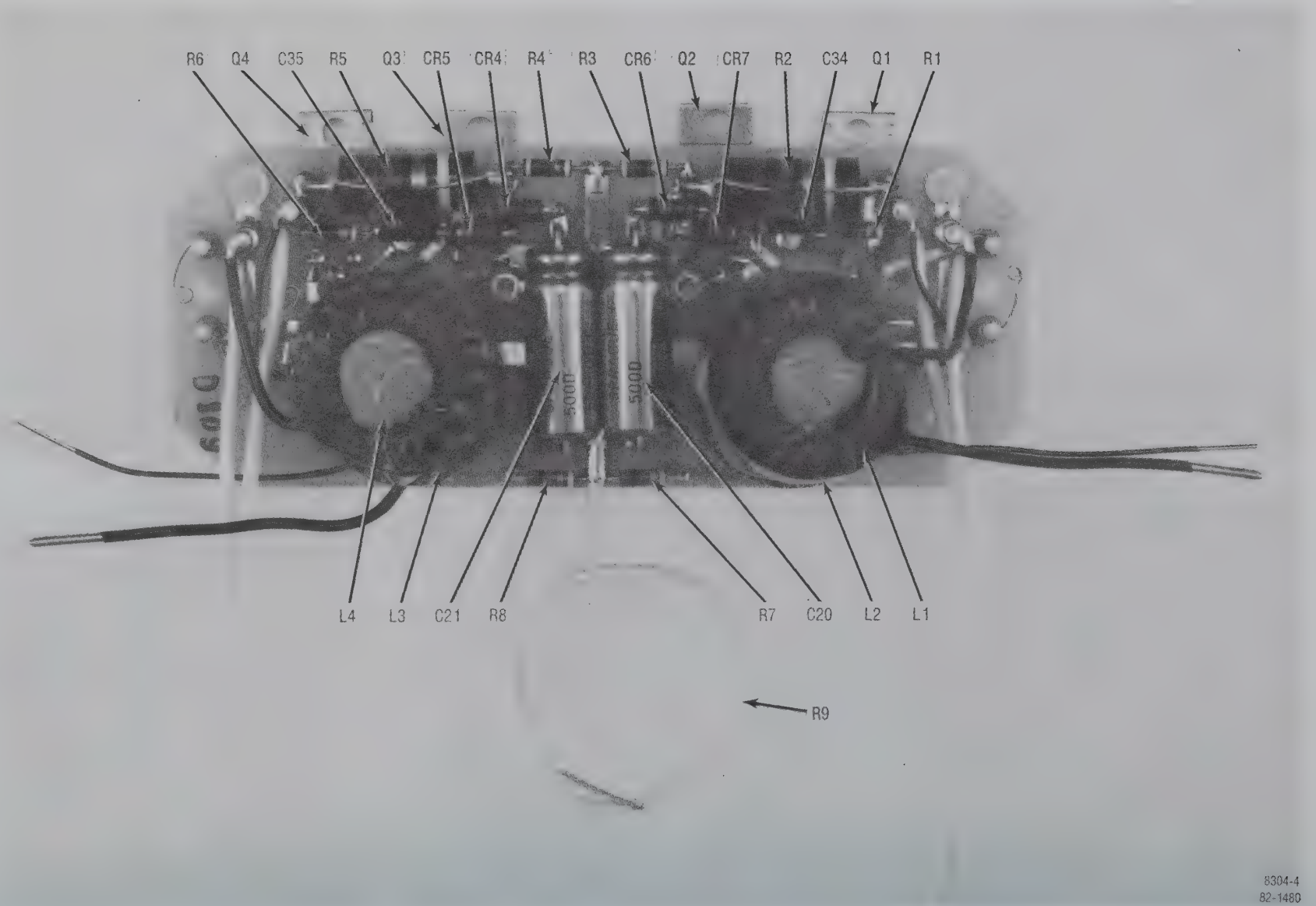

Figure 4-3. Converter PWB Asssembly Parts Location Diagram

Table 4-3. Converter PWB Assy 01-P07252L002, Parts List
(See Figure 4-3)

Reference Designation	Description	Part Number
C20,C21	50 μ f, 50V	500D506G050DD7
C34, C35	2200pf, 10% 200V	M39014/02-1326
CR4, CR5, CR6, CR7	Diode	1N4933
L1, L4	Coil	24-P02678R001
L2, L3	Coil	24-P02679R001
Q1, Q4	Transistor	D45H10
Q2, Q3	Transistor	D44H10
R1, R6, R7, R8	100-5%-1/4W	RCR07G101JS
R2, R5	560-5%-2W	RCR42G561JS
R3, R4	47-5%-1/4W	RCR07G470JS
R9	Resistor .001Ω	01-P03962T002 (2 Required)

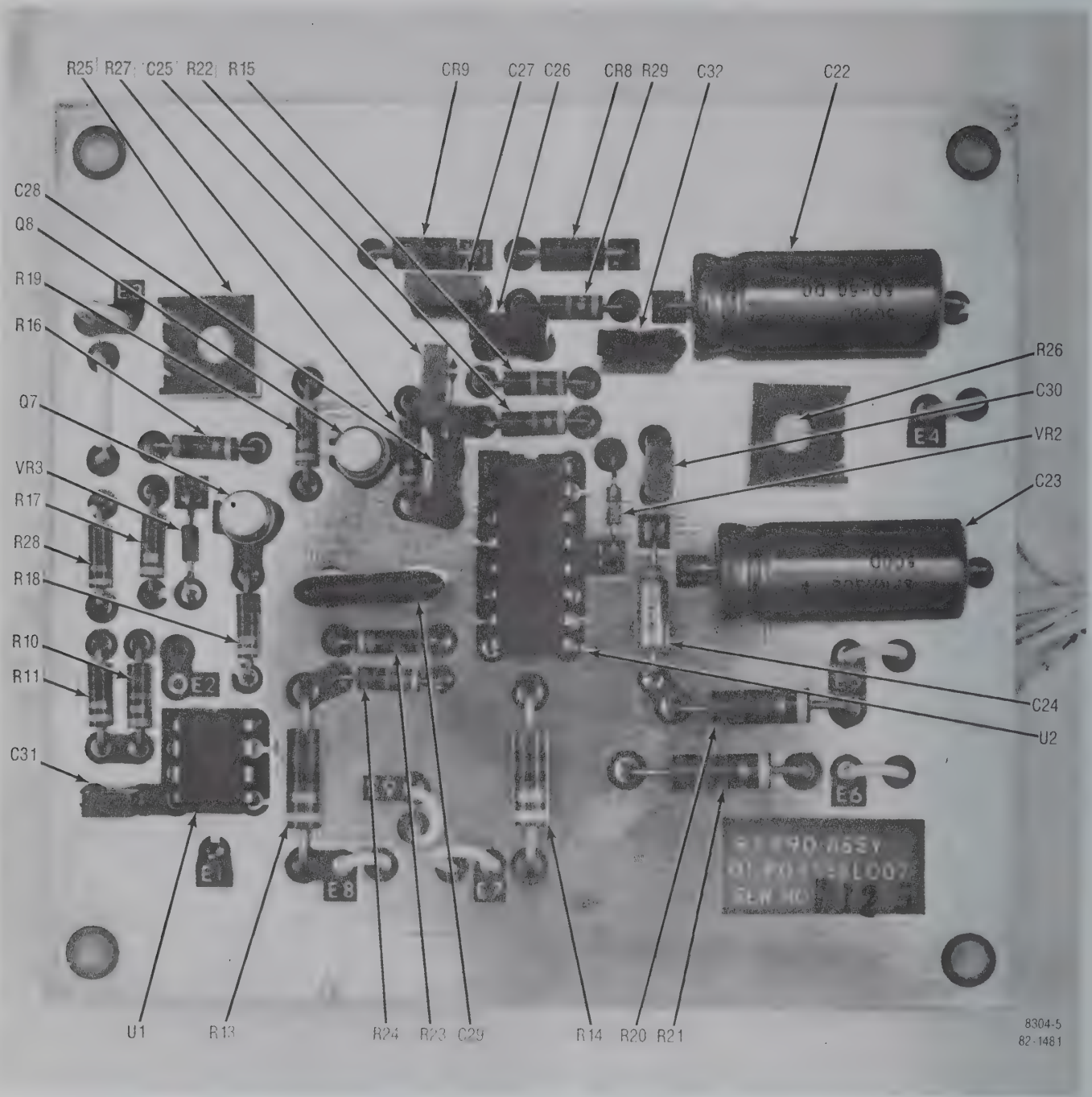

Figure 4-4. Control PWB Assembly Parts Location Diagram

Table 4-4. Control PWB Assy 01-P04558L002 Parts List
(See Figure 4-4)

Reference Designation	Description	Part Number
C22, C23	50µ f, 50V	500D506G050DD7
C24	1 µ f, 50V	M39003/01-2356
C25,C26	0.1 µ f,	M39014/02-1350
C28, C32		
C27	.047 µf	M39014/02-1345
C29	0.0022 µf	CM06FD222J03
C30	4700 pf	M39014/01-1569
C31	.022	M39014/02-1342
CR8,CR9	Diode	1N4933
Q7, Q8	Transistor	JAN2N2222A
R10	68K-5%-1/4W	RCR07G683JS
R11	5100-5%-1/4W	RCR07G512JS
R13	56-5%-1/2W	RCR20G560JS
R14	10-5%-1/2W	RCR20G100JS
R15	100K-5%-1/4W	RCR07G104JS
R16	3000-5%-1/4W	RCR07G302JS
R17	5600-5%-1/4W	RCR07G562JS
R18	8200-5%-1/4W	RCR07G822JS
R19	4700-5%-1/4W	RCR07G472JS
R20, R21	220-5%-1/2W	RCR20G221JS
R22	10K-5%-1/4W	RCR07G103JS
R29	82K-5%-1/4	RCR07G823JS

Table 4-4. Control PWB Assy 01-P04558L002 Parts List (Cont)
(See Figure 4-4)

Reference Designation	Description	Part Number
R23	8.2K-5%-1/4W	RCR07G822JS
R24	12K-5%-1/4W	RCR07G123JS
R25	10K Potentio-meter	E2A103
R26	100 Potentio-meter	E2A101
R27	1M-5%-1/4W	RCR07G105JS
R28	560-5%-1/4W	RCR07G561JS
U1	IC	MC3523U
U2	IC	TL494CN
VR3	Diode, Zener	1N753
VR2	Diode, Zener	1N968

Table 4-5. AC Power Cable, 30-P09258W002, Parts List

Description	Part No.
PTAD-101 Mating Connector	MS3116F14-5S
Power Cord	30-29922C85

Table 4-6. DC Power Cable, 30-P09258W003, Parts List

Description	Part No.
PTAD-101 Mating Connector	MS3116F14-5S
Power Cord	Beldon Type 8454